SOCIETAL IMPACTS
OF
MICROELECTRONICS

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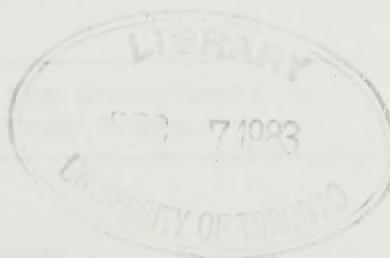
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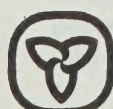
SOCIETAL IMPACTS

OF

MICROELECTRONICS

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Study commissioned under the Government of
Ontario Microelectronics Task Force.

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EXECUTIVE SUMMARY

Three major areas of societal impact were identified: work environment, skills and knowledge, and public interest. A number of issues are summarized below for each area with a corresponding recommendation. These recommendations are intended to be suggestive of the role that governments can play in ensuring that all of society benefits as microelectronics technology is developed and applied. Some further ideas for implementation of the recommendation are also suggested.

A. The Work Environment

1.

ISSUE: *The introduction of microelectronics into the work place could improve both the quality of the working environment and increase productivity.*

RECOMMENDATION: IDENTIFY AND STIMULATE RESEARCH AND DEVELOPMENT INITIATIVES THAT INCREASE PRODUCTIVITY WHILE IMPROVING THE QUALITY OF THE WORK ENVIRONMENT.

IMPLEMENTATION:
- Create awards or otherwise provide recognition for successful initiatives that have improved the work environment.
- Fund development proposals that are likely to increase productivity and to improve the quality of the work environment.
- Support basic research.

2.

ISSUE: *Absence of agreement between business and labour may interfere with applications of microelectronics in the work place.*

RECOMMENDATION: ASSIST IN THE RESOLUTION OF BUSINESS/LABOUR ISSUES RELATED TO THE USE OF MICROELECTRONICS IN THE WORK PLACE.

IMPLEMENTATION: • Collect and disseminate information describing resolutions of business/ labour issues related to the use of microelectronics.
• Use existing industry/labour forums to discuss the issues and to look for joint solutions; explore possibility of creating a new consultative body for industry and labour to focus on resolution of these issues.
• Support of basic research.

B. Skills and Knowledge

1.

ISSUE: *Microelectronics will significantly increase the demand for people with specialized skills. Existing teacher training and career counselling methods will have to adjust.*

RECOMMENDATION: DEVELOP TIMELY, RELIABLE AND SKILL SPECIFIC FORECASTS FOR USE IN CAREER CHOICE AND TRAINING PROGRAM DEVELOP- MENT. SUPPORT THE DEVELOPMENT OF EDUCATIONAL TRAINING AND COUNSELLING SERVICES THAT MEET THE DEMAND FOR EMERGING JOB-RELATED SKILLS AND KNOWLEDGE.

IMPLEMENTATION: • Refine existing forecasting of skill needs and career opportunities.
• Refine existing training, educa- tional and counselling services, using microelectronics where appropriate.

2.

ISSUE: *The impact of microelectronics on everyday life, e.g. through elec- tronic banking, teleshopping, etc. will increase the need for new and different computer related abilities and knowledge.*

RECOMMENDATION: SUPPORT COMPUTER LITERACY PROGRAMS BOTH WITHIN AND OUTSIDE TRADITIONAL EDUCATION INSTITUTIONS.

IMPLEMENTATION: • Increase the commitment of resources to develop computer literacy pro- grams in educational institutions.
• Support the development of computer literacy programs, including methods for delivering these programs to the widest possible range of people.

3.

       ISSUE: *Microelectronics technology has the potential to provide the physically handicapped and other needy groups with new opportunities for self-sufficiency and participation in, and contribution to, society.*

RECOMMENDATION: SUPPORT THE USE OF MICROELECTRONICS TO AID SPECIAL GROUPS, E.G. THE PHYSICALLY HANDICAPPED.

IMPLEMENTATION:
- Promote successful applications of microelectronics that aid special groups.
- Support initiatives that promise to use microelectronics to aid special groups.
- Support research to identify new opportunities for using microelectronics to aid special groups.

C. Public Interest

1.

       ISSUE: *The increased use of microelectronics for collecting, analyzing and retrieving information may reduce its accessibility to the general public.*

RECOMMENDATION: SUPPORT THE WIDER AVAILABILITY OF MICROELECTRONICS-BASED INFORMATION SERVICES THROUGH EXISTING COMMUNITY INFORMATION CENTRES AND PUBLIC LIBRARIES.

IMPLEMENTATION:
- Fund acquisition by public libraries of equipment for accessing information services.
- Support the development of new information services.
- Regulatory agencies should be encouraged to approve new microelectronic-based information service initiatives.

2.

ISSUE: *Public lack of awareness of the
implications of microelectronics
technology for everyday life could
result in unfounded concerns and
missed opportunities.*

RECOMMENDATION: SUPPORT THE DELIVERY OF PUBLIC
AWARENESS AND EDUCATION PROGRAMS
HIGHLIGHTING OPPORTUNITIES FOR
INDIVIDUALS AND BUSINESS.

IMPLEMENTATION:
- Identify target groups for
  awareness programs.
- Act as a "clearing house" for
  information and resources.
- Fund the development and imple-
  mentation of an information and
  awareness program.

3.

ISSUE: *The spread of microelectronics is
likely to produce public concerns
that cannot be completely resolved
by public awareness programs.*

RECOMMENDATION: RESPOND TO PUBLIC CONCERNS REGARDING
THE SOCIETAL IMPACT OF MICROELECTRONICS.

IMPLEMENTATION:
- Monitor public opinion related to
  the societal impact of microelec-
  tronics.
- Develop and implement appropriate
  measures to deal with legitimate
  public concerns regarding the
  societal impact of microelectronics.

INTRODUCTION

I. The broad objective of the Task Force on Microelectronics
    was to develop policies and programs to ensure that Canada
    and Ontario would obtain the optimal benefits from current
    and future developments in microelectronics. Within this,
    the Task Force was to contribute a better understanding of
    the nature of the technology as well as how it impacts on
    business and industry, educational institutions, govern-
    ments and government agencies, labour and society. In
    addition to the Executive Summary the report consists of a
    Background section, the Issues and Recommendations section
    and finally Appendices.

    In conducting its investigation, the Advisory Group set for
    itself three main tasks: 1) to identify the major areas in
    which microelectronics has societal impacts, 2) to examine
    the issues associated with each area of impact, and 3) to
    recommend appropriate responses to each issue.

    The Ministry of Transportation and Communications (MTC) was
    one of those Ministries asked to assist the Task Force and
    did so by setting up an Advisory Group which prepared this
    background paper on societal impacts.

    Appendix A is a selected bibliography listing the works which
    had the greatest impact on this Advisory Group. Appendix B
    lists the names of individuals and groups who were consulted
    at various stages in our work. Appendix C is a brief des-
    cription of the public opinion poll conducted to gauge the
    interests, hopes and concerns of North Americans regarding
    the societal impacts of microelectronics.

II. BACKGROUND

The applications of microelectronics will be diverse and per-
vasive, and the potential societal impacts are significant.
The study of these impacts is valuable not only in its own
right, but also because societal impacts will be one of the
strongest determinants of economic, labour and educational
effects.

It should be stated at the outset that this Advisory Group
has come away from its research with an optimistic attitude,
but not so optimistic as to suggest that governments can ignore
the situation. The Group is convinced that goverment has a
role to play, in concert with others, in ensuring that the
spread of microelectronics technology serves the best interests
of society.

In discussing a role for goverment in the context of micro-
electronics development, a number of key messages were repeated
many times by knowledgeable individuals interviewed throughout
Canada and the United States. There was agreement on the need
for:
> . government leadership and innovation
> . flexible, long term policy development
> . relating initiatives to the inherent strengths
>   of Ontario/Canada

A. Government Leadership and Innovation

Government's ability to deliver social programs, to stimu-
late industrial development, etc. are founded in large
measure on revenue sources that are stable and predictable.
Over the decade of the 1970's many events have shaken
that foundation and the 1980's offer little or no promise
of improvement. These events include the internationali-
zation and interdependence of many countries economies,
the growth in the power of the multinationals, the oil
"crises" of 1973-'74 and 1979-'80, the evolution of a

remarkably different global economic order etc., and
result in government's loosened rein on the forces that
bring about change. Whether it can be described, as some
do, as the economies of the industrial democracies being
in ruins because of policies of OPEC, Japan and the Third
World or that these same economies are undergoing a
consciously chosen reindustrialization at a pace that
minimizes shocks and ensures long-term optimum performance
is largely theoretical. What is clear is that given these
shifts in economic power and the strong pressures for
restraint in public spending, governments should consider
productive interventionist models and/or partnership
options. As a partner with business and industry, govern-
ment can enhance its effectiveness in ensuring that its
objectives are achieved.

The challenge is to select the mix of interventionist
roles and partnerships, given the initiative, that best
suits the government's political/social/economic environ-
ment. This task is best addressed when implementation
strategies are being considered.

B. Flexible Long-Term Policy Development

From a public policy perspective, long-term planning in
the case of microelectronics is as important, and perhaps
more so, as in many other areas of government responsi-
bility. While relying on the best possible understanding
of both technology and society, predictions about their
interaction must be made with caution and flexibility.
It must be remembered that future technological and social
developments are a product of human creativity and inven-
tiveness, both difficult to predict.

The uncertainties and risks associated with technological
and social change and interaction argue for governments
to maintain a large element of flexibility in their
policies and programs.

C. Inherent Strengths of Ontario/Canada

In its discussions inside and outside the Province, the
Advisory Group received various comments identifying
the following perceived strengths of Ontario:

. the education system in general
. community colleges
. universities
. libraries and community information services
. urban life-styles
. recreational facilities
. cultural amenities
. transportation systems, services and technology
. communication systems, services and technology
. health and medical services and associated technology
. proximity to large markets

The implementation of recommendations should take into
consideration the strengths that are inherent in Ontario.
For example in any campaign to attract new industry to
Ontario the above could be accentuated.

III. ISSUES AND RECOMMENDATIONS

The Advisory Group has identified three areas of societal
impact that require the attention of government and its
agencies: the work environment, skills and knowledge, and
public interest. There are a number of issues associated
with each impact area. Each issue is discussed and appro-
priate responses are recommended, followed by some ideas
for implementation.

A. The Work Environment

The potential impacts of microelectronics in the work
place are complex and interrelated. Two major objectives
of the Ontario government are to increase productivity
and to improve the quality of working life. It will be a
challenging task to introduce microelectronics in a way
that serves both of these objectives. Interrelated issues
associated with this impact area are: the potential for
microelectronics to displace jobs and the introduction of
new factors into the area of negotiation between business
and labour.

1. Productivity and the quality of working life

The motives for introducing microelectronics into the
work environment are complex. The most obvious benefit
is improved productivity, but microelectronics can
also reduce stresses and hazards, and make jobs more
interesting. One general principle which has wide
support is that application of microelectronics must
be accepted by those who will be affected. The success
of any such application could be as dependent on
changes in the quality of working life as on changes
in productivity.

In fact, a public opinion poll conducted on behalf
of the Advisory Group indicates that Ontarians are
optimistic about the impact of microelectronics on
the quality of working life. There are positive
expectations about the impact of microelectronics on
the following job characteristics: interest, hazards,
stress, pay and challenge (see Table 1, Appendix C).
The optimism regarding pay may reflect employees'
expectation that microelectronics will also make them
more productive. Table 1 also indicates that
Ontarians are not as optimistic in this area as U.S.
residents. With the exception of job stress, U.S.
residents have even higher expectations than Ontarians
about the impact of microelectronics. This relative
pessimism adds extra weight to the importance of
impacts on the work environment in Ontario. The issue
identified above can be stated as follows:
*The introduction of microelectronics into the work
place could improve both the quality of the working
environment and increase productivity*.

The role of government in regard to this issue is to
encourage developments of mutual long-term benefit to
affected employers and employees as well as to suppliers
and manufacturers of equipment and systems for the work
place. Developments that improve both productivity
and quality of working life, implemented in Ontario,
can be expected to have considerable export potential.
It is recommended that the government:

IDENTIFY AND STIMULATE RESEARCH, DEVELOPMENT AND
IMPLEMENTATION THAT INCREASE PRODUCTIVITY WHILE
IMPROVING THE QUALITY OF THE WORK ENVIRONMENT.

There are at least three approaches that could be
used to implement this recommendation. The first step
would be to create awards for new initiatives. A
second step would be to fund development and imple-
mentation proposals that are likely to increase
productivity and to improve the quality of the work
environment. These proposals could come from employers,
employees, suppliers, manufacturers or any combination
of these groups. The last step involves a more long-
term approach. While specific initiatives are being
identified and funded, it is important to fund basic
research in this area, to promote a deeper understan-
ding of why certain initiatives are successful and to
lay the groundwork for future developments.

2.   The relationship between business and labour

As microelectronics applications increase productivity
and improve the quality of working life, a secondary
impact could be the displacement of jobs, among which
could be many that are inefficient or undesirable.
Although the displacement of jobs because of new
technology is not exactly a "new" factor in business/
labour relations, the spread of microelectronics
could accelerate the rate of displacement. Work
environments in which technology has not previously
produced significant job displacement could also
be affected. The adjustments to production pro-
cesses and to allocation of work assignments because
of microelectronic technology could be a source of
dispute in business/labour relations.

Of the job impacts presented in the poll, the only
one that Ontarians are not optimistic about is job
security (see Table 1). Again the contrast with

U.S. expectations suggests a relative pessimism in
Ontario. The issue can be stated as follows:
Absence of agreement between business and labour
may interfere with applications of microelectronics
in the work place.

The role of government is to support business and
labour in their efforts to obtain the optimal benefits
from the application of microelectronics in the work
place. The record of business/labour relations in
this area will have a significant impact on the attrac-
tiveness of Ontario as a place to develop and implement
microelectronics-based work equipment and systems. It
is recommended that government can play a role in:
ASSISTING IN THE RESOLUTION OF BUSINESS/LABOUR ISSUES
RELATED TO THE USE OF MICROELECTRONICS IN THE WORK
PLACE.

A preliminary step in implementing this recommendation
would be to collect and disseminate information des-
cribing recent resolutions of business/labour issues
related to the use of microelectronics. There would
be three benefits to this approach: first, it would
assist interested parties in understanding the con-
text in which present negotiations are taking place;
second, it could provide models of successful resolu-
tions of issues related to microelectronics; and third,
it would provide a positive picture of business/
labour relations in Ontario to those considering the
introduction of microelectronics into the work place,
or of expanding or relocating business, in Ontario.

A more long-term approach to this issue would involve
the support of basic research in this field. A better
appreciation of the impact of microelectronics on
business/labour relations could be developed through a

review of for example, the impact on business/labour
relations of technology in general so as to promote
the positive results achieved as well as to forewarn
as to the problem areas. A comparison of government
approaches to this issue in different jurisdictions
may also be useful.

B. Skills and Knowledge

The impact of microelectronics on job-related skills and
knowledge was not discussed in the previous section. The
point of discussing this issue in a separate section is
that the spread of microelectronics will also have effects
on skills and knowledge required outside the work environ-
ment. This widespread impact will be significant because
people will increasingly be able, or be required, to use
intelligent machines in their everyday life. This develop-
ment will change both how things are done and what things
are done; the skills and knowledge that people need will
be altered accordingly.

Within this general area of impact, three issues have been
identified: one is related to the work environment; a
second is related to a particular skill, computer literacy;
the third is related to those special groups of people who
are likely to benefit most from the spread of microelectronics.

1. Job related skills and knowledge

In the previous section, it was proposed that micro-
electronics technology has the potential to improve
both the quality and the productivity of the work
environment. If these improvements are achieved, four
related effects are likely to follow, each of which
would tend to alter the demand for job-related skills
and knowledge.

As intelligent machines increasingly mediate between
the worker and the product or service, the ability to
operate these new machines will become essential and
some previously acquired abilities will become less

important or indeed obsolescent. Second, microelec-
tronic components will allow manufacturers to create
new products and services, some of which will compete
effectively with existing products and services.
This will also change the demand for job-related
knowledge and skills. Third, job-related require-
ments to learn new skills and acquire new knowledge
will produce a demand for new systems to support
the required training and education. Many of the
people involved in the development and delivery of
these services will also need to acquire new skills
and knowledge, and many existing training profes-
sionals will have to adapt to new approaches to
training. Finally, this increasingly dynamic work
environment will compel people to improve their
ability to anticipate which skills and knowledge they
will need to further their own careers or indeed to
compete effectively in the job market. There will be
a resulting increase in the demand for well informed
career counselling services. The issue can be stated
as follows:

*Microelectronics will significantly increase the
demand for specialized new knowledge in the work
place. Existing teacher/training and career counsel-
ling methods will have to adjust or be obsolete.*

The role of government is to support business and
labour in adapting to these changes. The effective-
ness with which Ontarians make this accommodation
will be an important factor in the economy of the
Province and in the job satisfaction of its residents.
It is recommended that government:

DEVELOP TIMELY, RELIABLE AND SKILL SPECIFIC FORECASTS
FOR USE IN CAREER CHOICE AND TRAINING PROGRAM DEVELOP-
MENT. SUPPORT THE DEVELOPMENT OF EDUCATIONAL TRAINING
AND COUNSELLING SERVICES THAT MEET THE DEMAND FOR NEW,
JOB-RELATED SKILLS AND KNOWLEDGE.

During times of rapid change, there is nothing more valuable than a good prediction. The first step in implementing this recommendation is to anticipate changes in demand for job-related knowledge and skills. Of course, a variety of activities related to this objective are currently taking place, but government could take a more active role in stimulating, supporting and integrating these activities.

The increasing need for workers to acquire new skills and knowledge will enhance the value of services that effectively train, educate, and provide career counselling. Fortunately, the new technologies that are responsible for these changes can also be applied to the task of helping people adapt. As the demands for future job related skills and knowledge are better understood, it will be possible to modify existing training, educational and counselling services, using microelectronics where appropriate.

The use of microelectronics in the delivery of these services has the additional advantage of providing a stimulus to those involved in the design and manufacture of the required hardware, software and courseware. The local market for these products and services could also provide a base for exports. A failure to support this kind of activity would leave the Ontario market open to imported systems and services. In addition to the economic and employment impacts, microelectronic-based course content would be added to Ontario's long list of imported cultural products.

2. Computer literacy

Many of the impacts of microelectronics on the work environment can be expected to find parallels in the wider context of everyday life. This broad impact is especially likely in the area of skills and knowledge.

Microelectronics technology promises opportunities to
work in different ways; it will also offer new ways
to learn, communicate, move, play, shop, and express
ourselves creatively. To take full advantage of these
opportunities, three challenges will have to be met:
acquire new skills and knowledge, develop the related
system for training and teaching, and forecast, and
prepare for, future opportunities. The issue can be
stated as follows:

The impact of microelectronics on everyday life,
e.g. through electronic banking, teleshopping, etc.
will increase the need for new and different abili-
ties and knowledge.

Computer literacy is the ability to interact capably,
confidently and comfortably with equipment incorpora-
ting some form of artifical intelligence, i.e. com-
puters or the ability to make effective use of micro-
electronics in ones everyday life. The role of
government is to support institutions that advance
this goal, but separate attention should be given to
educational institutions, because their mandate is
especially relevant to the task, and because education
is a Provincial responsibility. It is recommended
that government:

SUPPORT COMPUTER LITERACY PROGRAMS BOTH WITHIN AND
OUTSIDE TRADITIONAL EDUCATION INSTITUTIONS.

Implementation of this recommendation will be direct
when acting through government institutions and
more supportive in other cases. The Ministry of Edu-
cation in Ontario has already begun initiatives in
this area and it is recommended that the government of
Ontario increase its commitment of resources to develop
computer literacy programs in educational institutions.
In this case it is recommended that support be given

<u>to the development of computer literacy programs, in-
cluding methods for delivering these programs to the
widest possible range of people</u>.

There are two kinds of benefits that can be expected
from programs that effectively raise computer literacy
in Ontario. One benefit is that computer literate
people will be better able to take advantage of the
opportunities offered by microelectronics. Secondly a
computer literate population in Ontario would also
provide a more receptive climate for the diffusion of
microelectronics and a local market that could help the
local microelectronics industry compete internationally.

3. <u>Special groups</u>

The previous two issues in the section focus on the
need to help the average resident of Ontario develop
the new skills and knowledge needed to adapt to the
spread of microelectronics. The recommendations assume
that the typical Ontario resident is reasonably well
adapted to the present environment and needs help
because microelectronics will change that environment,
for better or worse. For some residents of Ontario,
microelectronics technology is more than a factor
promising new risks and opportunities, it represents
a chance to share opportunities taken for granted by
the average Ontarian.

The most obvious case of such a special group is the
physically handicapped. For example, television
caption systems allow the deaf and hard-of-hearing to
fully enjoy TV programs for the first time. Other
microelectronics-based systems allow those with communi-
cation, locomotion, or coordination disabilities to be-
come more self-reliant and to become productive members
of the Ontario work force. Microelectronics can provide
important benefits to the disabled, but it also offers

opportunities to other groups with special needs, e.g.
the elderly, members of minority language groups, and
remote populations. It is important to investigate
the full range of groups that can benefit from the
use of microelectronics. The issue can be stated as
follows:

*Microelectronics technology has the potential to
provide the physically handicapped and other needy
groups with previously unavailable and/or impossible
opportunities for self-sufficiency and participation
in and contribution to society.*

In concert with others, government has always played
an active role in identifying disadvantaged groups and
providing them with appropriate assistance. In the
context of this report, the role of government is to
ensure that microelectronics technology is effectively
used as a part of this process. It is recommended
that government:

SUPPORT THE USE OF MICROELECTRONICS TO AID SPECIAL
GROUPS, E.G. THE PHYSICALLY HANDICAPPED.

In many cases, the first step in implementing this
recommendation has already been taken; many disadvan-
taged groups have been identified and progress has
been made in understanding their special needs. For
some groups, appropriate initiatives have already been
taken to apply microelectronics to these special needs.
Implementation would start with actions to promote and
support the development of applications of microelec-
tronics that aid special groups. A careful study of
successful programs of this type will provide a good
basis for the next step: to support initiatives where
microelectronics are used to aid special groups. A
long term approach to this issue is also required.
Government should be prepared to support research to
identify new opportunities for using microelectronics
to aid special groups.

The benefits of the actions proposed above will
depend on the particular combination of group
and application, but the benefits need not be for
the group alone. Consider, for example, a system
designed to help minority language groups improve
their communication skills. The benefits to the
group are obvious, but the successful development
of such a system would also help these groups make
better contributions to their work place, their
community and society in general. Using microelec-
tronics to bring improved communications, social
and cultural services to remote populations could be
part of existing or future regional development
programs. Of course, any successful application of
microelectronics in the resolution of the problems
of special needy groups could provide a base for
exports and the capturing of a share of the global
market.

C. Public Interest

The issues that remain are not related to any particular
impact area; rather they are part of the general pattern
of change that microelectronics is likely to produce.

The first issue is related to the fact that microelec-
tronics will facilitate, indeed encourage, the produc-
tion, storage and analysis of large amounts of information.
Access to that information will also tend to involve the
use of microelectronics. The second issue is related to
societal change as a general phenomenon and the need for
public awareness of the changes that microelectronics is
producing and will produce. The third issue is related
to the public reaction to these changes, expressed in the
form of hopes and concerns, and the need for appropriate
responses.

1. Public access to information services

The spread of microelectronics is likely to increase the importance of information because of the ease with which vast and complex amounts of information can be collected, stored, analyzed and retrieved. If, as is likely, this development involves extensive use of microelectronics, the technology that supports the creation of this information handling capacity could also constitute an impediment to its use by the general public. Initially at least, only large organizations will have the resources required to take full advantage of this development. This barrier can be partially overcome through the computer literacy programs recommended in the previous section, but there remains a problem of access.

Private interests may not coincide with the public interest in regard to access, with serious consequences as the result. The danger is in accelerating the creation of an information gap in society where those who are information poor are increasingly excluded from the advantages and benefits access to information confers.

That this issue is of public concern is indicated by response to a survey question that asked Ontarians to anticipate whether "greater use of computers to handle information will...allow information to be controlled by more people or allow information to be controlled by fewer people"? Significantly more people (52%) chose the former alternative than the latter (37%) with the remainder expressing no opinion. The issue can be stated as follows:
The increased use of microelectronics for collecting, analyzing and retrieving information may reduce its accessibility to the general public.

The role of government in regard to this issue is complex, but an analogy with printed information is instructive. Government support for public libraries

and community information centres ensures that the
time and money required to obtain printed information
is not an insurmountable barrier to the general
public. Selective support is also available from
government for publications that are expected to be
of general public benefit. It is recommended that
government:

SUPPORT THE AVAILABILITY OF MICROELECTRONICS-BASED
INFORMATION SERVICES THROUGH EXISTING COMMUNITY
INFORMATION CENTRES AND PUBLIC LIBRARIES.

Implementation of this recommendation follows the
pattern of support that government has established
in regard to printed information. With the objective
of greater availability to the general public, govern-
ment should fund acquisition by public libraries of
equipment for accessing information services. Govern-
ment should also be prepared to support the development
of new information services that are likely to avoid
creation of an information gap in society but require
funding.

Microelectronic-based information services will be
provided in a more complex regulatory environment than
that of printed information. One important difference
is the likely involvement of broadcasters, telecommuni-
cations common carriers and the cable TV industry in
addition to the traditional publishers. There is a
risk that the regulatory environment in which these
industries operate will constrain the development of
new information services. To counteract this tendency
the relevant regulatory agencies should be encouraged
to approve new microelectronic-based information
service initiatives by those industries. There should
be no restriction on the development and delivery of
information services in a democratic society.

There are three benefits of generally available, micro-electronic-based information services. First, being able to access useful information will increase the motivation and the opportunity to become computer literate. Second, the availability of these new services will make for a better informed public. Third, a wide market for information services will provide a stimulus to the microelectronics industry.

2. Public awareness and education

The proliferation of information is just one of the expected societal impacts of the spread of micro-electronics but it is clear that developments in this area must continue to be monitored. The need for further study is especially important given the general level of public awareness. According to the survey referred to above, only nine percent (9%) of Ontarians say they "know a lot" about microelectronics. This level of awareness may not be high enough to ensure the optimal societal benefits of microelectronics. The issue can be stated as follows:

Public lack of awareness of the implications of micro-electronics technology for everyday life could be harmful because of unfounded concerns and missed opportunities.

Improved public awareness is a goal shared by many, including: business, labour, educational institutions, community service groups, religious organizations, and government. The role of government is to act in concert with others to help the general public anticipate the societal impacts of microelectronics. It is recommended that government:

SUPPORT THE DELIVERY OF PUBLIC AWARENESS AND EDUCATION PROGRAMS HIGHLIGHTING OPPORTUNITIES FOR INDIVIDUALS AND BUSINESS.

Implementation of this recommendation requires close
coordination with others sharing the goal of public
awareness. As a preliminary activity, government
should identify target groups for the awareness pro-
grams.

As part of its activity to continue monitoring the
societal impacts of microelectronics, government
should share the fruits of this labour with the public
and act as a "clearing house" for information and
resources.

As particular impacts and target groups are clearly
identified, government should also fund the develop-
ment of information and awareness programs designed
to raise public awareness.

There are three main benefits of improved public
awareness: an informed public is more likely to benefit
from the spread of microelectronics, the industry will
encounter less of the resistance to change that is
based on ignorance and confusion, and political deci-
sions related to microelectronics will be more democratic
because public opinion will be better informed.

3. Public Concerns

Any development as diverse and pervasive as the spread
of microelectronics is likely to produce some public
apprehension. Public awareness and education programs
will provide some assurance, but these general programs
will not resolve all public concerns related to the
societal impact of microelectronics.

The nature of current public concerns is indicated by
responses to a question on the previously mentioned
survey of public opinion. Respondents were given a
list of thirteen issues related to microelectronics
and were asked to indicate which were the five most

important. The issue chosen most often was privacy
and confidentiality of personal information. Sixty-
three percent (63%) of respondents picked that issue
as one of the five most important. The next three
most important issues were accuracy of billing,
control of information and job security (see Table 2,
Appendix C). The general issue identified in this
section can be stated as follows:

The spread of microelectronics is likely to produce
public concerns that cannot be resolved by general
public awareness programs.

The role of the government is to collaborate with
appropriate parties to resolve public concerns
regarding the societal impacts of microelectronics.
It is recommended that government:

RESPOND TO PUBLIC CONCERNS REGARDING THE SOCIETAL
IMPACT OF MICROELECTRONICS.

Given the potential diversity of these concerns, it
is unlikely that any single implementation strategy
will be appropriate for all concerns. Nevertheless,
two activities would appear to be useful as preliminary
steps. To take appropriate action, it is necessary to
assess the specific nature of these concerns. The
first step, therefore, would be to monitor public
opinion related to the societal impact of microelec-
tronics. The poll conducted by the Advisory Group is
an exploratory step in that direction. Once public
concerns are identified and reasonably well understood,
a second step is to dispell misinformation and exag-
gerated concerns. This activity could involve support
of existing public awareness and education programs,
but additional government initiatives may be necessary.

Although these preliminary steps will resolve many
public concerns, others will simply be clarified and
will ultimately require a response. In this case, the
third step would be to consider appropriate measures
to deal with legitimate public concerns regarding the
societal impact of microelectronics.

One example of the Ontario Government's response to
similar concerns has been the establishment of commis-
sions of inquiry, for example the Williams Commission
and the Krever Commission.

Depending on the nature of the public concern, other
approaches may be considered more appropriate, and
it would be useful to examine initiatives taken in
other jurisdictions. In the case of the personal
privacy issue, for example, consideration should be
given to existing legislation in the U.S., Sweden,
France and West Germany.

If the public knows that the government will respond
to legitimate concerns in this area, they will be more
likely to face, with confidence, the rapid societal
changes that microelectronics technology is likely to
produce.

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APPENDIX B: CONSULTANTS AND RESEARCH STAFF

The research staff of the Advisory Group on Societal Impacts drew on the expertise of a number of individuals and groups. These contacts were useful in finding a strategy for investigating this complex area, identifying issues and developing recommendations.

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APPENDIX C: POLL OF PUBLIC OPINION RELATED TO THE
              SOCIETAL IMPACTS OF MICROELECTRONICS

Over 2500 adult residents of Ontario and the United States
participated in face-to-face interviews as part of omnibus
polls conducted in February and March of 1981. All respondents
were asked standard demographic questions as well as a series
of questions about how the future spread of microelectronics
technology might affect them and society in general.

The samples, designed to be representative of the general
population, consisted of 1085 residents of Ontario and 1589
residents of the United States. In both countries, results
were weighted to eliminate biases caused by under representation
of certain "difficult to reach" population groups.

In both countries, the same questions were asked at about the
same time of year, similar sampling techniques were used and
the interview techniques were similar. It is therefore assumed
that any differences in response reflect different attitudes
in the two countries.

TABLE 1:   Expectations of Ontario and U.S. residents
           regarding the impact of microelectronics
           on their jobs.

IMPACT	PERCENT OF RESPONDENTS AGREEING	
	ONTARIO	U.S.
MORE INTERESTING	49	55
MORE BORING	26	14
LESS HAZARDOUS	35	41
MORE HAZARDOUS	18	11
LESS STRESSFUL	45	46
MORE STRESSFUL	26	23
HIGHER PAYING	39	43
LOWER PAYING	16	13
MORE CHALLENGING	45	48
LESS CHALLENGING	31	21
MORE SECURE	28	33
LESS SECURE	34	27

NOTE 1:

        The "No Change" and "Don't Know" responses
for each impact added to above %'s will total 100%.

TABLE 2: Ontario residents' judgments of the five
most important societal issues related to
microelectronics.

ISSUE	PERCENT OF RESPONDENTS WHO JUDGE ISSUE AS IMPORTANT
PRIVACY AND CONFIDENTIALITY	63
ACCURACY OF BILLING	46
CONTROL OF INFORMATION	45
JOB SECURITY	44
JOB PAY	38
JOB SAFETY	38
COMPUTER CRIME	34
COST OF HOME EQUIPMENT	30
INFORMATION ABOUT WHAT ORGANIZATIONS ARE DOING	29
JOB STRESS	28
JOB INTEREST	27
JOB CHALLENGE	25
COMPLEXITY OF HOME EQUIPMENT	18

TABLE 3:   Questionnaire administered as part of omnibus
           polls in Ontario and the United States.

ASK EVERYONE

HAND CARD

Please look at this card and read it carefully.

In recent years, electronics have changed our world. Many
of the machines we use now have extra buttons and dials,
memories, and communication links to other machines. Some
of these machines can perform complex tasks automatically,
and a few seem to be able to think.

Imagine that, perhaps surprisingly soon, electronics will
make familiar machines more efficient and more automatic.
Also imagine that electronics will soon make available some
machines that are quite different from any you have seen.
In the questions that follow, we ask how this new technology
will affect you; how these changes might improve your life;
how they might make it worse.

The first group of questions deals with your work in the
future.

   1. Are you currently employed outside of the home
       full-time, part-time or not at all?

       FULL-TIME
       PART-TIME
       NOT AT ALL - SKIP TO Q.3

TABLE 3 cont'd

ASK ALL "FULL-TIME" AND "PART-TIME"

2. In places where people work, there could be more
    computers, robots, intelligent typewriters, electronic
    calculators, TV display screens, etc. If there is
    more of this kind of equipment soon where you work,
    we would like you to think for a moment how it will
    affect your job.

    I am going to hand a number of cards to you one at a
    time, listing some of the things that might happen
    because of these changes. Please read the card through
    first, and then I will ask you which of each of the
    possible alternatives you believe will be true for
    you. SHUFFLE CARDS AND HAND TO RESPONDENT ONE AT A
    TIME.

    Will your job be:

    a. More interesting?
        More boring?

        ABOUT THE SAME
        CAN'T SAY

    b. Less hazardous to your health
        More hazardous to your health

        ABOUT THE SAME
        CAN'T SAY

    c. Less stressful?
        More stressful?

        ABOUT THE SAME
        CAN'T SAY

    d. Higher paying?
        Lower paying?

        ABOUT THE SAME
        CAN'T SAY

    e. More secure?
        Less secure?

        ABOUT THE SAME
        CAN'T SAY

    f. More challenging?
        Less challenging?

        ABOUT THE SAME
        CAN'T SAY

TABLE 3 cont'd

ASK EVERYONE

3. The second group of questions deal with your home in
    the future.

    New electronic technology could be used in more of
    the equipment people use at home. Of course, the
    effect of this equipment on you personally will
    depend on whether you have it in your home and on
    how well it works.

    HAND CARD

    Here is a card listing six different categories of
    equipment that could be made available soon.

    Please read through the different types and then I'll
    ask you, for each category, whether you think you
    will or will not buy them, and if so, why.

    The response categories are listed on this card. Just
    indicate the number opposite the response that fits
    you best.

    HAND CARD

    WON'T BUY
    WILL NOT NEED

    WON'T BUY
    TOO EXPENSIVE

    WON'T BUY
    TOO COMPLICATED

    WON'T BUY
    WILL NOT CHANGE LIFE

    WILL BUY
    WILL CHANGE LIFE

    DON'T KNOW

    a. Improved home appliances and tools allowing
        you to do better work with less effort and
        new jobs you previously couldn't do.

    b. Improved home entertainment equipment giving
        you better and more varied programs.

    c. Equipment that provides better information
        about your world.

    d. Equipment that makes your life and property
        more secure.

    e. Equipment that makes it easier to learn skills
        useful in school, at jobs or at home.

    f. Equipment that makes it easier to communicate
        with friends and family.

TABLE 3 cont'd

Increased amounts of information about individuals is being
collected and stored by business and institutions such as
schools, hospitals, and governments. Although some of the
information is now handled by computers, this could increase
dramatically in the near future.

4. I am going to hand some cards to you one at a time
    each with a pair of opposing statements.

    At the top of each card is a scale showing at one end
    complete agreement with the left-hand side statement
    and at the other end complete agreement with the right-
    hand side statement. I'd like you to read each pair
    of statements and tell me what point on the scale
    best represents your opinion. SHUFFLE CARDS AND HAND
    TO RESPONDENT ONE AT A TIME.

    Greater use of computers to handle information will ...

    a. Produce more mistakes and confusion.
                      OR
        Produce fewer mistakes and less confusion.

    b. Make it easier to find out what organizations
        are doing.
                      OR
        Make it more difficult to find out what
        organizations are doing.

    c. Protect the privacy and confidentiality of
        personal information.
                      OR
        Reduce the privacy and confidentiality of
        personal information.

    d. Allow information to be controlled by more
        people.
                      OR
        Allow information to be controlled by fewer
        people.

TABLE 3 cont'd

HAND CARD

5. I am now going to hand you a card that has a number
   of issues associated with the introduction of micro-
   electronics. From this card, I would like you to
   choose the 6 issues that you personally feel are
   most important. Please read all issues before
   responding. Just give me the letters beside the
   statements you choose.

   a. Privacy and confidentiality of personal
      information.

   b. Accuracy of computerized billing.

   c. Opportunities for computer crime.

   d. Information about what organizations
      are doing.

   e. Number of people controlling information.

   f. Cost of home equipment and appliances.

   g. Complexity of home equipment and
      applicances.

   h. Interest value of jobs.

   i. Safety of jobs.

   j. Stress associated with jobs.

   k. Security of employment.

   l. Challenge of jobs.

   m. Pay and wages for jobs.

TABLE 3 cont'd

IF "PRIVACY OF PERSONAL INFORMATION" CHOSEN IN Q.5, ASK:

6. In response to the last question, you expressed con-
    cern about the effect of micro-electronics on the
    privacy of personal information. Looking ahead for
    the next five years, do you think that your privacy
    will be invaded or seriously disturbed by: ROTATE
    ORDER

    Any of your neighbours?
    Anyone from work?
    A caller at your home?
    Anyone telephoning you?
    Anything else you have received in the mail?
    The publication of information about you on
    radio, TV, in newspaper?
    Anyone who could interfere with your mail?
    A credit rating agency?
    A bank?
    A computer or databank?
    A department store?
    Insurance companies?
    A hospital, medical laboratory, or
    medical center?
    A school, community college or university?
    Local government?
    Provincial government?
    Federal government?
    NONE OF THE ABOVE

ASK EVERYONE

7. We have just asked you a number of questions about
    micro-electronics technology. Of course, this topic
    is more familiar to some people than to others.
    Which one of the following best describes what you
    personally know about micro-electronic technology?
    READ LIST ....

    I know a lot about micro-electronic technology
    through direct experience in my job, at school,
    as part of a hobby or otherwise.

    I know something about micro-electronic technology
    through reading, TV or through discussions with
    others.

    I know very little about micro-electronic technology.

    DON'T KNOW.